

Excellence in plant control HyCon Control System



HyCon Control System

Voith Hydro is one of the global leaders in hydropower plant equipment and services for both new and modernization projects.

Our reputation for excellence in products and services is based on reliability, trust and commitment in long-lasting, partnering relationships with owners and operators around the world.

This applies to overall plant engineering as well as to single component and system design in electrical and hydraulic machines, including the entire range of hydropower plant control concepts and systems. We offer hydro automation

from a single source to ensure complete service and to ensure seamless availability for your hydropower plant and all of its components and systems.

Our automation solutions are based on a variety of subsystems that ensure a safe, reliable and cost-effective operation through our long-term process know-how and control system expertise in hydropower applications.

From these systems, the control system is the central interface between the operator and the hydropower generation process. Our HyCon Control Systems offer perfect solutions for safe and reliable hydropower control.



The HyCon Control System family is tailor-made to meet the specific requirements of each hydropower plant. It thus provides second to none reliability, functionality and safety.

Proven technology meets highest quality and reliability standards

Voith offers its portfolio of automation solutions under the name HyCon, characterized by highest quality and reliable approved technology, in order to fulfill all demands in terms of control and supervision, in line with market and customer necessities of delivering a sustainable solution in the long term.

Seamless integration

Today integration and smart handling of assets is becoming more and more important. Integration of all digital and mechanical systems within the hydropower plant into one control philosophy is a must. Within the HyCon family all subsystems are fully integrated into the control system. This includes not only turbine governor and either voltage regulator or excitation, but also electrical and mechanical protection. This is an invaluable advantage for our customers with regard to maintenance and spare part management.

HyCon is an uniform solution with seamless integration of all systems.

Tailor-made solutions

The HyCon object library with functions tailored to the hydro process deliver plenty of advantages including:

- Flexibility for project specific modifications
- Slim and modern design
- Voith Hydro ownership
- Direct support up to third level

Voith guarantees and ensures an outstandingly high and constant quality level for all projects due to our centralized intensive system- and integration tests for all supported configurations.

Flexible and scalable solution for any hydropower plant

The Voith Hydro HyCon Control System is offering complete and comprehensive SCADA functionality for all power plant environments.

- The main advantage of HyCon solution is the full flexibility Voith guarantees in the engineering tool, and is prepared to fulfill all requirements of hydropower controls.
- The HyCon solution is also using the hydro specific library of objects and therefore are fitting perfectly to hydro applications.
- HyCon solution is scalable over a wide range of applications, from single station to distributed systems with different levels of redundancy.

Herdecke, Germany



HyCon Control System

The intelligent choice

Investment protection

Voith wants to ensure the maximum benefit from your HyCon Control System installation. As there is a discrepancy between the life cycle of the power unit and the control system and an even more significant discrepancy between the lifetime of the PLC and the operator stations respectively the servers of the control system, Voith is investing into clear strategies to protect your investments. To handle these discrepancies in a technically feasible and economically intelligent way we offer a clear migration and upgrade strategy to keep your control system efficiently up-to-date. This helps you to protect your investments.

To support this strategy Voith is offering a wide range of services tailored for HyCon Control Systems like:

- Spare parts handling and supply
- Modification of system functionality
- Telephone hotline support
- Service contracts
- Remote diagnosis support through OnPerformance.Lab
- Regular maintenance of the equipment on site: e. g.
 - Back-ups, check of all alarms, etc.
 - Start-up support after unit overhaul

Reliable operation

The proven operation philosophy applied in HyCon systems has been successfully implemented in hydropower plants of all types and sizes all over the world. A cornerstone of this concept is the fully object-oriented hydro block library using state-of-the-art faceplate technology for the operator station's displays.

This technology and other features, like the sophisticated sequence representation with special monitoring functions, make sure that the operator always has the overview on the status of the process even in difficult situations requiring special attention. Another feature to make the process transparent to the operator is the advanced fault tracking capabilities via picture tree and loop-in alarm.

Control room in Gigel Gibe, Ethiopia



Built-in plant safety

The control system provides reliable operation and is a key factor for plant safety. Our hydro block library is designed to meet the high level of safety standards embedded in all Voith hydro products to guarantee an optimum of safety for the user, the capital equipment, and the environment.

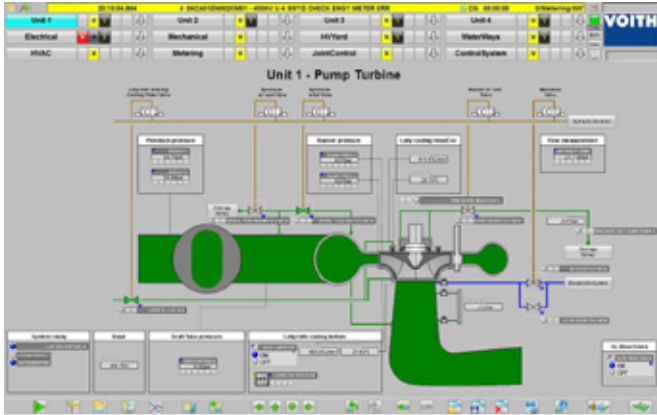
The mechanical protection is implemented in PLC (Programmable Logic Controller) technology. A sophisticated trip matrix concept allows high flexibility to define finely graduated responses to any abnormal events in mechanical subsystems.

IT/OT security

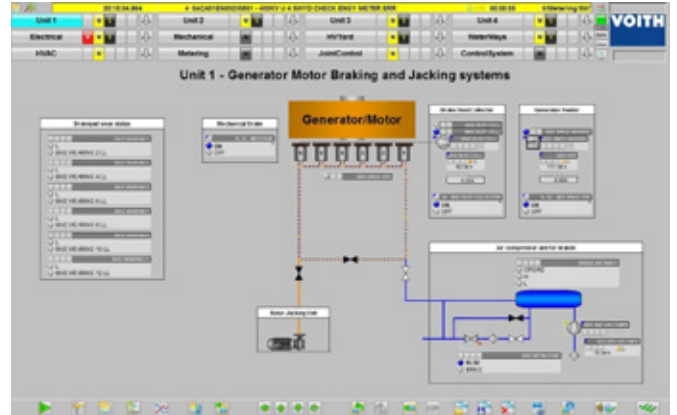
For all components of HyCon Control Systems measures are taken to safeguard protection from cyber attacks and system hardening. This includes that all functions not necessarily required for the operation of the system are deactivated or deleted (e. g. USB ports). Functions accessible over the network are reduced to a minimum and are individually adapted to the project specific needs. Thus the relevant international standards (like ISO/IEC 27002, ISO/IEC 27019, IEC 62351, NERC CIP-007-4) are met by our HyCon Control System family.

The HyCon Control System family features

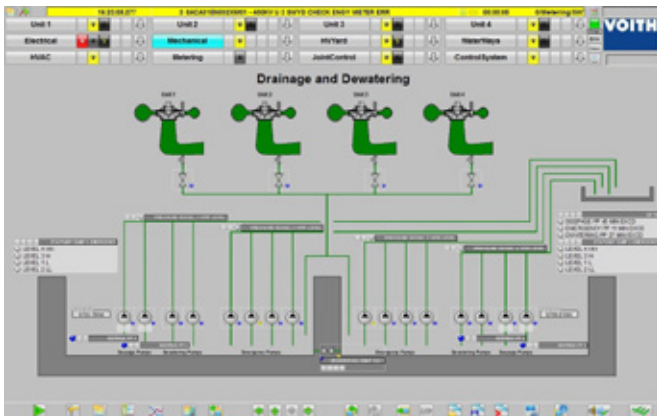
- **IT / OT security included, for examples firewalls and anti-malware tools**
 - **Flexible remote access solutions**
 - **Web interface**
 - **Messaging system support, for example pager and SMS**
 - **Control room equipment**
 - **Hierarchically structured access control**
 - **Parameter access and change without engineering tool**
 - **Ergonomic screen design based on international standards like IEC 60073 and others**
 - **Multiple language support (online switchable)**
 - **Hard and software diagnosis in the PLC controller**
 - **Powerful trend and archiving system**
 - **Central engineering tool with one central database**
 - **Historian functionality**
 - **Multi screen**
 - **Multi server**
 - **Multi clients**
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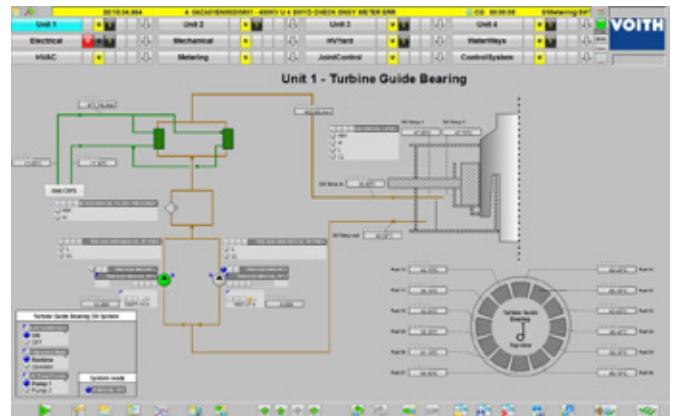
Pump turbine overview



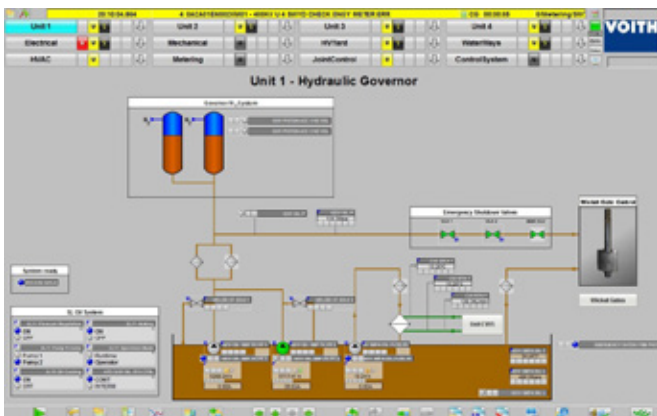
Braking system



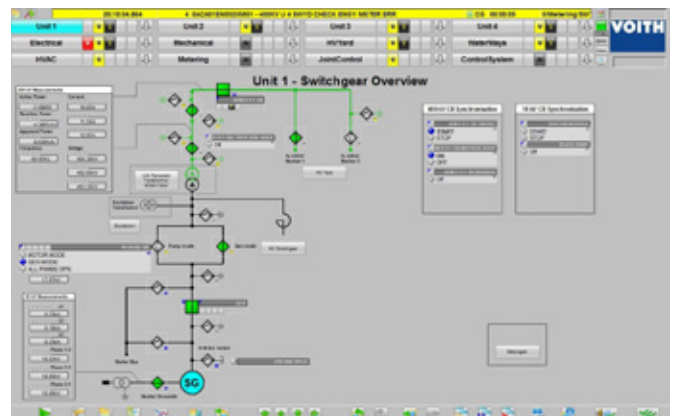
Drainage and dewatering



Turbine guide bearing



Hydraulic governor



Unit switch gear

HyCon Control System

Selected highlights

Sequences – Plant operation

The sequences build the brain of the control process of the hydropower plant operation. With the help of the sequences the power units are started, stopped and operated. Here not only the technological know-how of Voith to operate hydropower units is required but also the best-in-class programming to ensure safe and reliable operation in all operating modes.

- The documentation and definition of the sequences is done in one step, this avoids mismatches
- The definition of the sequences is done graphically
- There is an enhanced display of the transitions according to the parameterization
- Signal information within the sequences is shown as plain text and signal status
- In case of a failure the signal states are stored for later on diagnostics

Event matrix

- Any signal can be integrated in the event matrix
- Up to 32 responses can be defined (freely configurable without programming)
- In case of an event the causing signal and the response is highlighted
- The causing signal is stored and must be reset manually

Independent local operation

State-of-the-art control systems ensure high reliability of the central control system level especially if the servers are provided as a redundant solution. However, the capability for local operation, for example at the unit control cabinet, which is completely independent of the central server, is a real added value in each hydropower plant, for example for commissioning, recommissioning after maintenance work and in emergency cases. All HyCon Control Systems provide independent local operation using operation panels or panel PCs.

Open communication

Open communication standards are an absolute must for a modern power plant control system. HyCon supports a wide range of open interfaces including IEC 60870-5-101/103/104 and IEC 61850. The Profibus DP/Profinet is the solution to communicate to decentralized I/Os, the most widely used field bus systems with more than 28 million installations worldwide. Voith is delivering highest quality. This includes certification for open communication standards to allow you a seamless integration of our solutions into your existing environment. The IEC protocol implementations provided by Voith have been certified by KEMA / TÜV Süd.

Built-in flexibility

Even though HyCon automation products are designed to provide an integrated overall automation system, all components may be used as stand-alone systems as well. HyCon Control Systems have been delivered for all types of hydraulic machines and generators. Due to the flexible concepts and the process expertise of Voith, the systems can be used for new plants as well as for modernization projects. HyCon Control Systems can be perfectly matched for any existing power plant in the world. It is our mission to have a solution for any challenge in hydropower automation. Several add-on functionalities can easily be integrated into HyCon Control System helping you to optimize the plant output.

Joint control

The HyCon JC – Joint Control is an integral part of the HyCon Control System library. It allows you to distribute the active and reactive power to all units within the power plant. The calculation of the optimal unit configuration is based on efficiency curves stored and processed in the PLC. This allows easy and safe operation of the complete plant. There are several additional features included like definition of a spinning reserve as a constraint. In mixed mode not all units must be assigned to the Joint Control (however units in manual mode are considered in total power balancing).

Operation

The Voith control system family is always pursuing one goal: We want to provide a comprehensive operation functionality for reliable control of the hydropower plant process. We reach this goal by providing an intuitive and flexible navigation for fast information access, e.g. you can jump from group alarm display straight to graphical representation and therefore have all information available on one click.

Intelligent alarm management

An intelligent alarm management helps to keep cool when there are unforeseen events. Our intelligent alarm management delivers the right alarms to the right person at the right time.

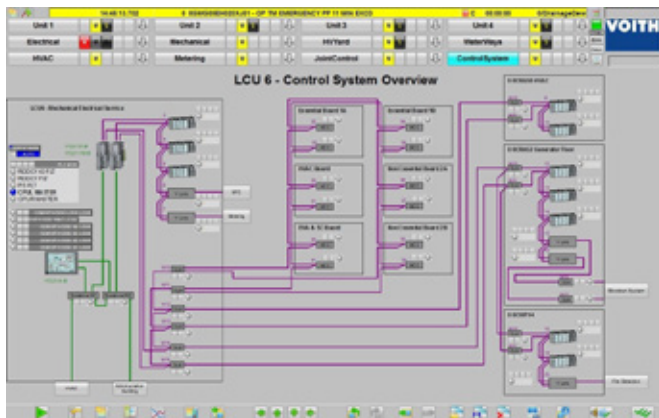
We can ensure this by several options:

Intelligent limiting of active alarms

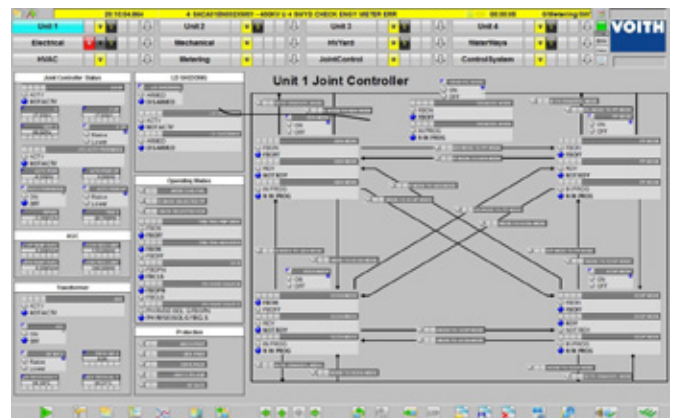
- Removes “non-relevant” alarms
- Filters “nuisance” alarms
- Suppresses alarms without defined “operator reaction“

Alarm prioritization

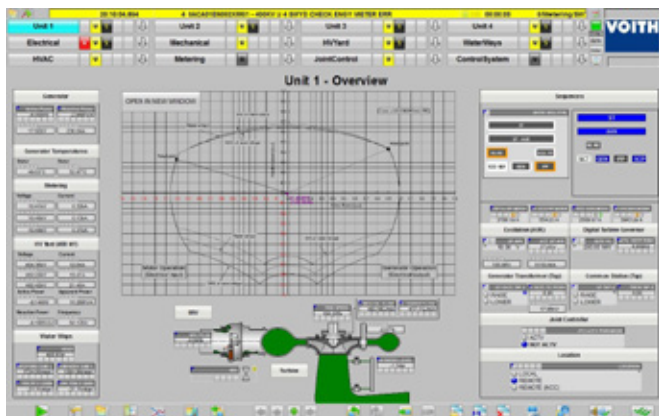
- Important alarms are always shown in the alarm line first
- A warning of the generator is more important than an alarm from another plant item



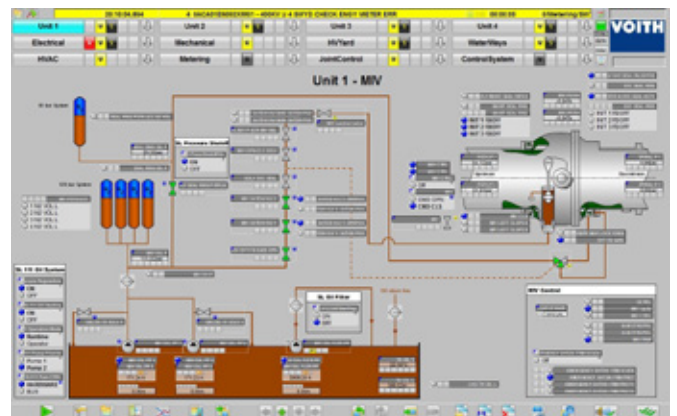
Control system – SCADA setup common section



Joint controller overview



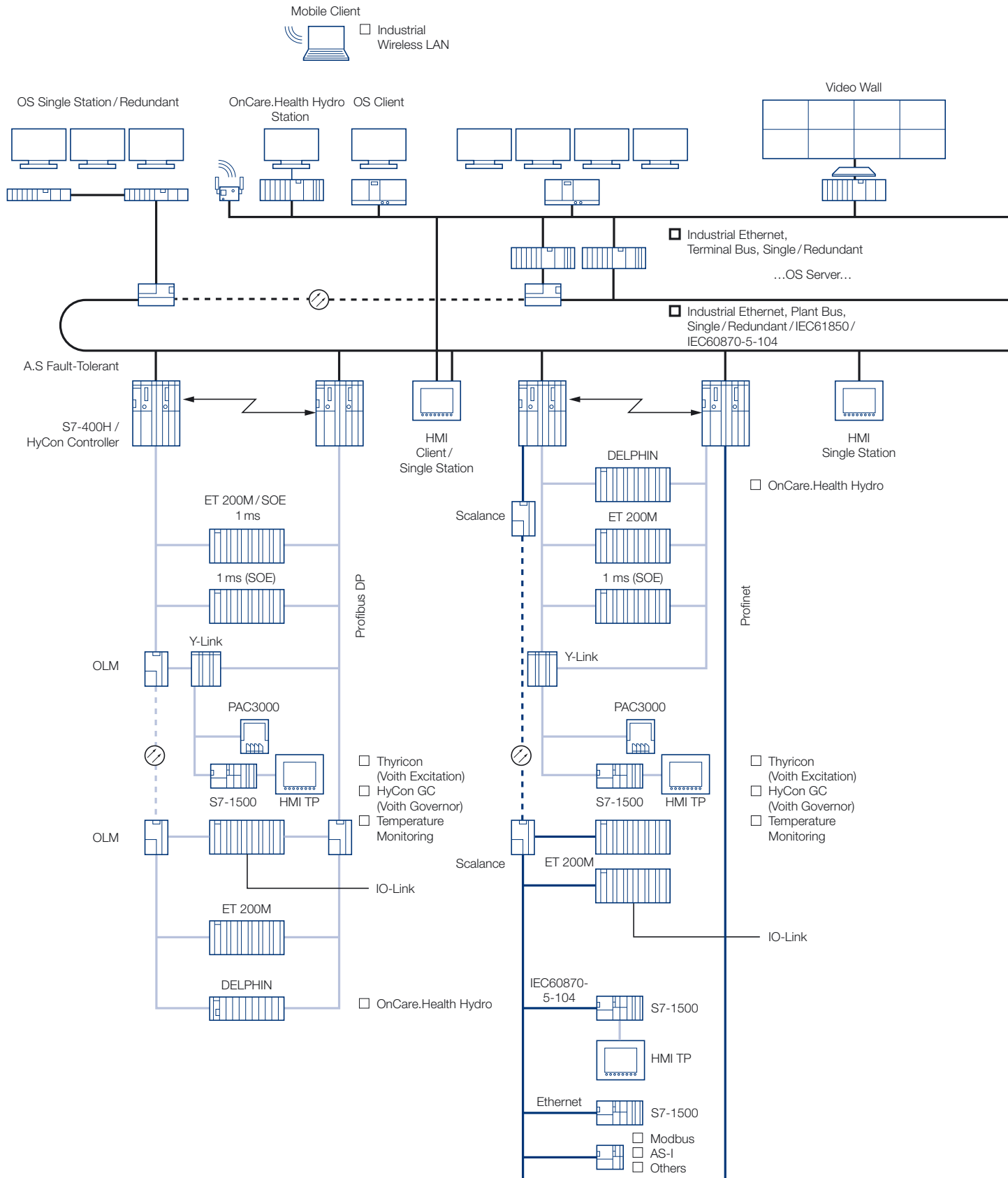
General overview

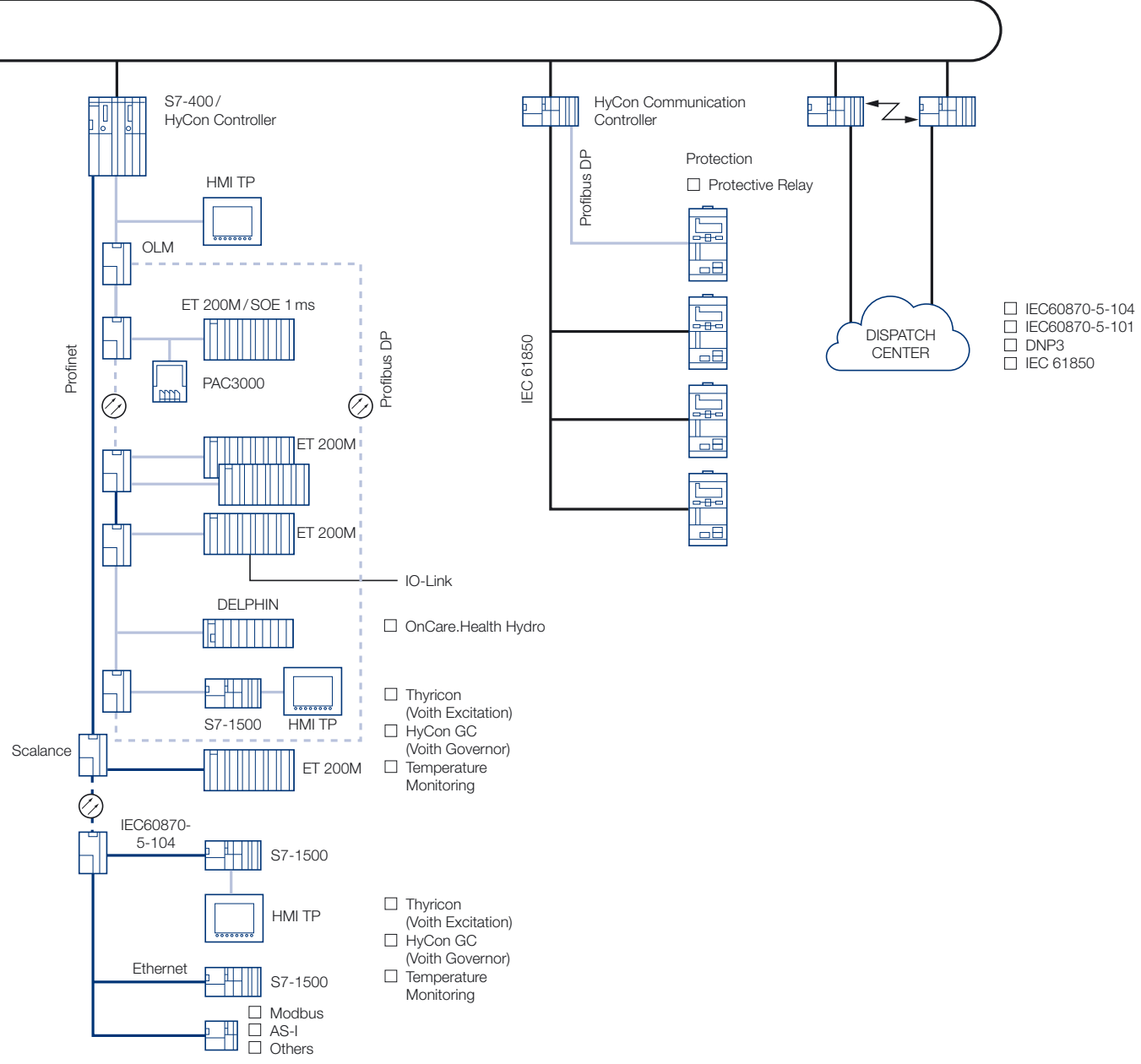
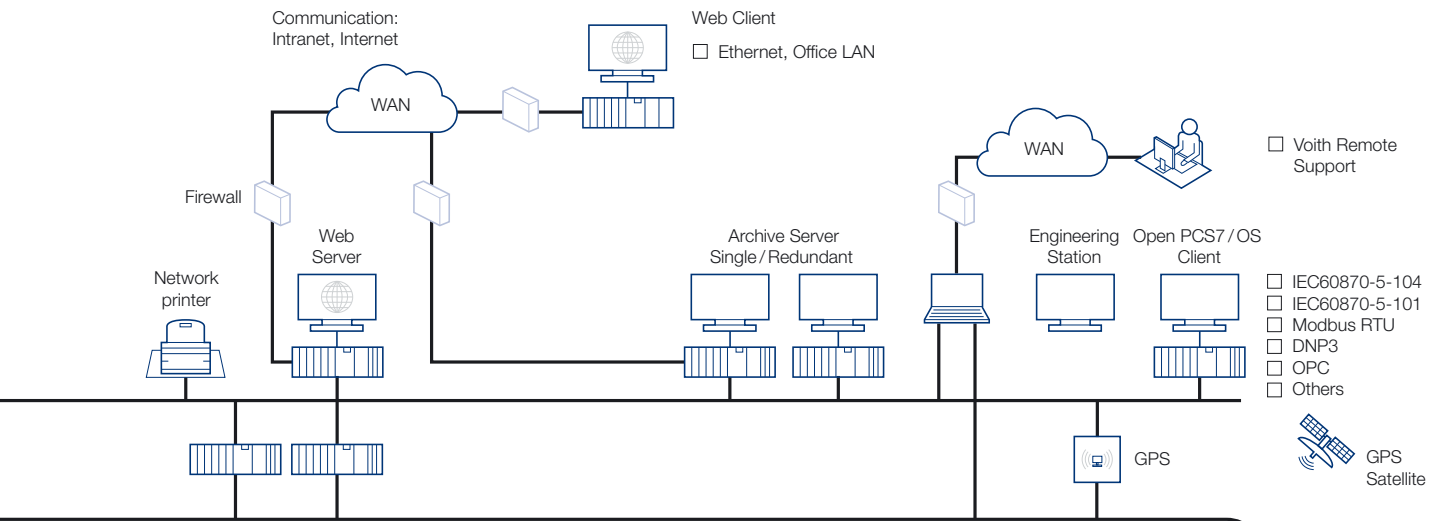


Main inlet valve

HyCon Control Systems

Hardware structure





High-end solution to satisfy all your needs

HyCon is designed to fulfill ambitious requirements such as the automation of pumped storage plants with very challenging demands regarding safety, reliability and stabilization of the grid. These are features which are especially crucial for power plants contributing to the primary control of the grid.

The HyCon control system is designed to cover a considerable range of requirements. For this purpose, HyCon is extremely scalable and – due to the modular design – the system can grow with the demands. Starting from a cost-effective all-in-one concept up to distributed architectures and redundancy in all levels of the system, HyCon is prepared to meet all your requirements.

Furthermore, a broad spectrum of standard interfaces allows the integration of existing components into the control system – this is especially valuable for modernization projects.

Redundancy concepts

To increase the availability of the control system several redundancy concepts are available, such as PLC redundancy, OS redundancy and network redundancy.

Major features in detail

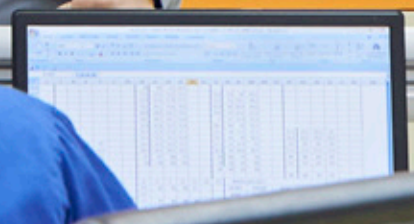
- **Scalable redundancy (hot stand-by) for PLCs, network, server.**
 - **Distributed server configurations for multi-unit plants, very complex auxiliaries and others.**
 - **Transparent user guidance and intuitive operation using faceplate technology.**
 - **Ergonomically designed process screens which help to focus the user attention to what is most relevant.**
 - **Local operation completely independent of the central server using the same screens and faceplates like in the central control room. Local server functionality provided if central server or communication fails.**
 - **Powerful and highly flexible representation of step sequences (optionally branched) including special monitoring functions for failure analysis. This concept is designed in particular to handle complex transitions for pump-turbines monitoring functions for failure analysis. This concept is designed in particular to handle complex transitions for pump-turbines.**
 - **Scalable archiving system with separate archive server as an option.**
 - **Flexible reporting tool based on MS Excel.**
 - **Central time synchronization server (GPS, NTP synchronization).**
 - **Alarm and messaging system supporting efficient disturbance analysis and fault tracking.**
 - **SOE for all messages like alarms and events.**
 - **Clear and transparent concepts for administration of user rights, interlocking of control locations and integrated alarm acknowledgement that is effective system wide.**
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S.N. EL. INGAI





References in recent years

- | | | | |
|-------------|--|-------------|--|
| 2013 | Sedrun, Switzerland
3 x 26 MW, Pelton units | 2015 | Ingula, South Africa
4 x 342 MW, Pump-turbine units |
| 2013 | Karcham Wangtoo, India
3 x 280 MW, Francis units | 2015 | La Muela II, Spain
4 x 213 MW, Pump-turbine units |
| 2013 | Alfalfal II (Alto Maipo), Chile
2 x 135.6 MW, Pelton units | 2015 | Cambambe II, Angola
4 x 180 MW, Francis units |
| 2013 | Churchill Falls, Canada
11 x 494 MW, Francis units | 2015 | Alecrin, Brazil
2 x 2 MW, Francis units |
| 2014 | Budarhals, Iceland
2 x 40 MW, Kaplan units | 2016 | Coo, Belgium
3 x 145 MW, 3 x 200 MW Pump-turbine units |
| 2014 | Bagliar II, India
3 x 150 MW, Francis units | 2016 | Smithland, United States
3 x 25 MW, Kaplan units |
| 2014 | Belo Monte, Brazil
18 x 620 MW, Francis units | 2016 | Willow Island, United States
2 x 21 MW, Kaplan units |
| 2014 | Barra-Votorantin, Brazil
3 x 1 MW, Francis units | 2016 | Achwa Uganda
3 x 10 MW, Francis units |



- 1 Budarhals
- 2 Frades II
- 3 Ingula
- 4 Smithland
- 5 Inga
- 6 La Muela



- 2017 Frades II, Portugal**
2 x 380 MW, VarSpeed Pump-turbine units
- 2017 Baglihar I, India**
3 x 150 MW, Francis units
- 2017 Mount Coffee, Liberia**
4 x 22 MW, Francis units
- 2017 Dakpsi 2B, Vietnam**
2 x 7 MW, Francis units
- 2018 Cannelton, United States**
3 x 29 MW, Kaplan units
- 2018 Inga I, Congo**
6 x 60 MW, Francis units
- 2018 Semangka, India**
2 x 29 MW, Francis units
- 2018 Alin B1, Vietnam**
2 x 23 MW, Francis units

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